NUCLEAR ENERGY RESEARCH INITIATIVE

Design and Development of Selective Extractants for An/Ln Separations

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Project Description

This project is designed to remove transuranic elements from spent nuclear fuel for storage or for reuse in transmutation processes. The proposed method will develop an efficient aqueous separation scheme for 1) recovering Am and Cm from the acidic liquid remaining after UREX+2 processing, which is used to remove U, Pu, Np, and Cs/Sr, and for 2) separating trivalent actinides from the fission product lanthanide ions. The project focuses on the continued development and optimization of the "NOPOPO ligands," which were previously demonstrated to be effective under laboratory-scale conditions, and which show promise as a large-scale process add-on to UREX+2.

The primary objectives of this project are to design, synthesize, and fully characterize the performance of 2,6-bis(phosphinomethyl)pyridine N,P,P´-trioxides (NOPOPO) as potential reagents for separating Am, Cm, and fission product lanthanides from other transuranics and fission products and for acting as a separations "platform" for the mutual separation of Am/Cm from the lanthanides. Preliminary analyses indicate that one member of the family of ligands, (EtHx)4NOPOPO, offers improved separation of Am^{3+} and Ln^{3+} ions from acidic aqueous solutions compared to the CMPO ligand used in the TRUEX process. The research is expected to produce a best-case extractant compound, which will undergo a complete round of synthesis optimization and performance characterization with a realistic raffinate simulant representative of the UREX+ process.

Workscope

The specific tasks will include:

- Optimize the NOPOPO synthesis
- Conduct further extraction testing of (EtHx)4NOPOPO
- Continue the study of phase compatibility and hydrolysis
- Characterize the radiolytic stability
- Design and synthesize new NOPOPO derivatives with improved solubility, phase compatibility and stability characteristics
- Conduct extractive testing of the new derivatives to determine their relative efficacy
- Conduct focused testing on the best-case extractant compound to optimize synthesis and characterize performance with realistic waste solutions
- Perform a cost analysis for the new process